

6(b) RF Troubleshooting and Manual Tuning

[This page left intentionally blank]

Table of Contents

	Page No
Introduction	5
Notes on reference measurements.....	5
Helgo / Synthesizer Troubleshooting.....	6
N500 Helgo troubleshooting	7
Synthesizer troubleshooting.....	8
Tx Troubleshooting.....	9
Tx 900 GMSK troubleshooting.....	10
Tx 1800/1900 GMSK troubleshooting.....	11
Rx Troubleshooting	12
Rx 900 troubleshooting	13
Rx 1800 troubleshooting	14
Rx 1900 troubleshooting	15
Bluetooth / FM Radio Troubleshooting	16
Bluetooth troubleshooting	17
FM radio troubleshooting	18
Service Tool Concept for RF Tunings	19
Service concept for RM-14 RF tunings	20
Receiver Tunings.....	21
RX channel select filter calibration.....	21
RX calibration.....	22
EGSM900 band	22
GSM1800 band	24
GSM1900 band	25
RX band filter response compensation	26
EGSM900 band	27
GSM1800 band	30
GSM1900 band	31
Transmitter Tunings	33
TX power level tuning	33
EGSM900 PA High Mode with EDGE off	34
EGSM900 PA high mode with EDGE on	35
GSM1800 PA high mode with EDGE off	36
GSM1800 PA high mode with EDGE on	37
GSM1900 PA high mode with EDGE off	38
GSM1900 PA high mode with EDGE on	39
TX I/Q tuning.....	40

EGSM900 band with EDGE Off	40
EGSM900 band with EDGE On	42
EGSM1800 band with EDGE Off	42
GSM1800 band with EDGE On	42
GSM1900 band with EDGE Off	42
GSM1900 band with EDGE On	43

List of Figures

	Page No
Fig 1 Helgo/Synthesizer	6
Fig 2 PA/TX.....	6
Fig 3 Helgo/Synthesizer	9
Fig 4 PA/TX.....	9
Fig 5 TX 900 GMSK troubleshooting	10
Fig 6 TX 1800/1900 GMSK troubleshooting	11
Fig 7 Helgo/Synthesizer	12
Fig 8 PA/TX.....	12
Fig 9 RX 900 troubleshooting.....	13
Fig 10 RX 1800 troubleshooting.....	14
Fig 11 RX 1900 troubleshooting.....	15
Fig 12 Bluetooth/FM	16
Fig 13 Bluetooth troubleshooting	17
Fig 14 FM radio troubleshooting	18

Introduction

This document is the troubleshooting guide for RM-14. On the following pages you will find a step-by-step fault finding procedure and reference measurements at the relevant signal points.

Note! Most test points are not accessible unless shielding cans are cut open. This must ONLY be done by the Return Analysis technicians and for analysis only!

■ Notes on reference measurements

- LF & DC signals are measured with Textronix 100 MHz Scope (TDS3014) and P3010 13pF probe.
- RF signals are measured with R&S FSIQ 7GHz Spectrum Analyzer and Agilent resistive divider probe (10dB, 500ohm).
- Please be aware that the RF connector on service adaptor is leaking power (into air) and acts as noise source when probing on RX chain. In 1800 band the problem is most severe while there is no external LNA to amplify the signal above the noise level like in the 1900 band. In 900 band the leakage is not as high due to lower frequency.
- GSM SA settings: RBW=500kHz, VBW=500kHz.
- Bluetooth SA settings: RBW=2MHz, VBW=2MHz.
- All reference measurements were made on a RM-14 phone (GSM900).
- RF loss Module Repair Jig: 900: 0.6 dB, 1800: 1.1dB and 1900: 1.2dB. Bluetooth is 1.8dB.

Helgo / Synthesizer Troubleshooting

Figure 1: Helgo/Synthesizer

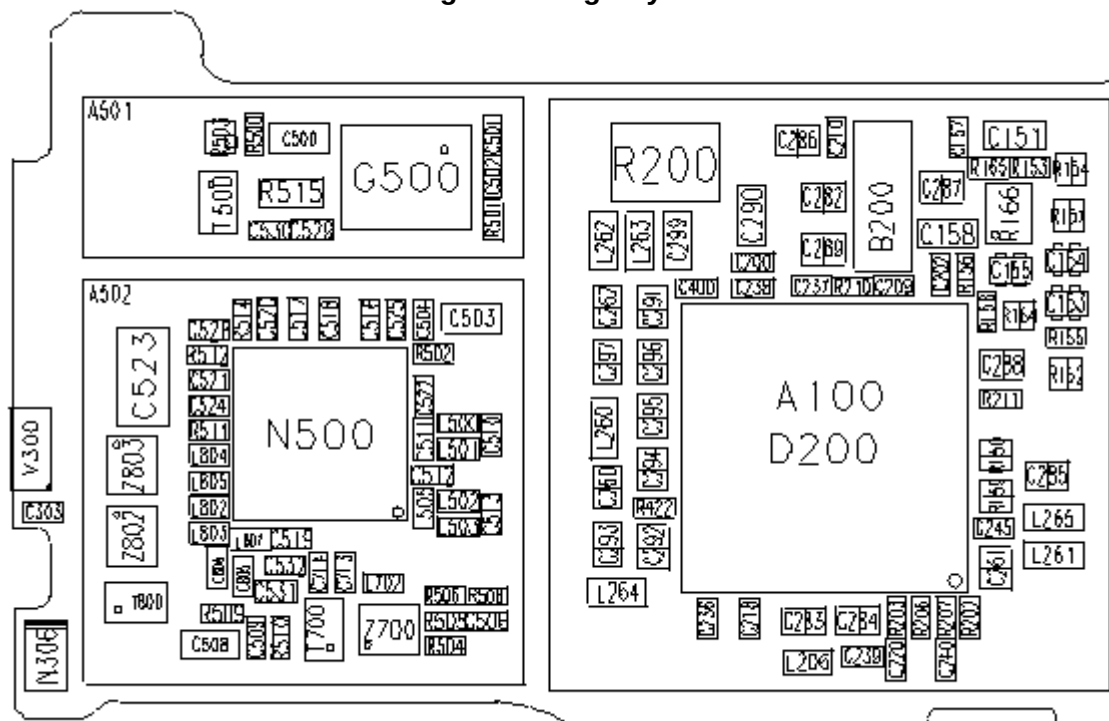
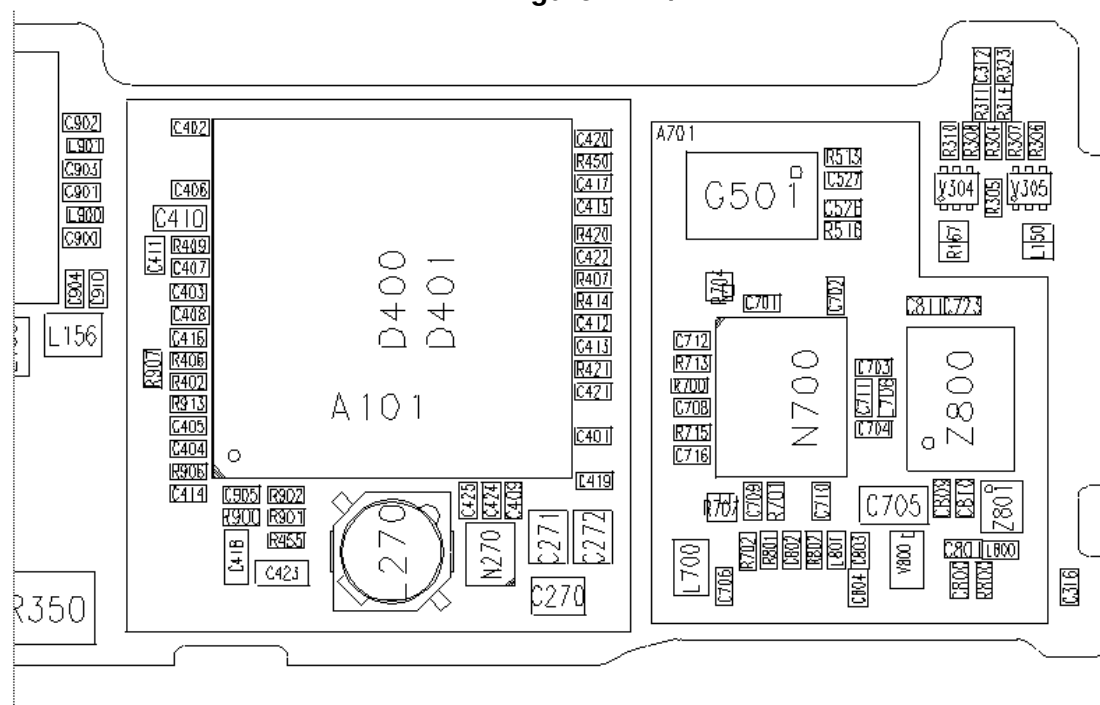
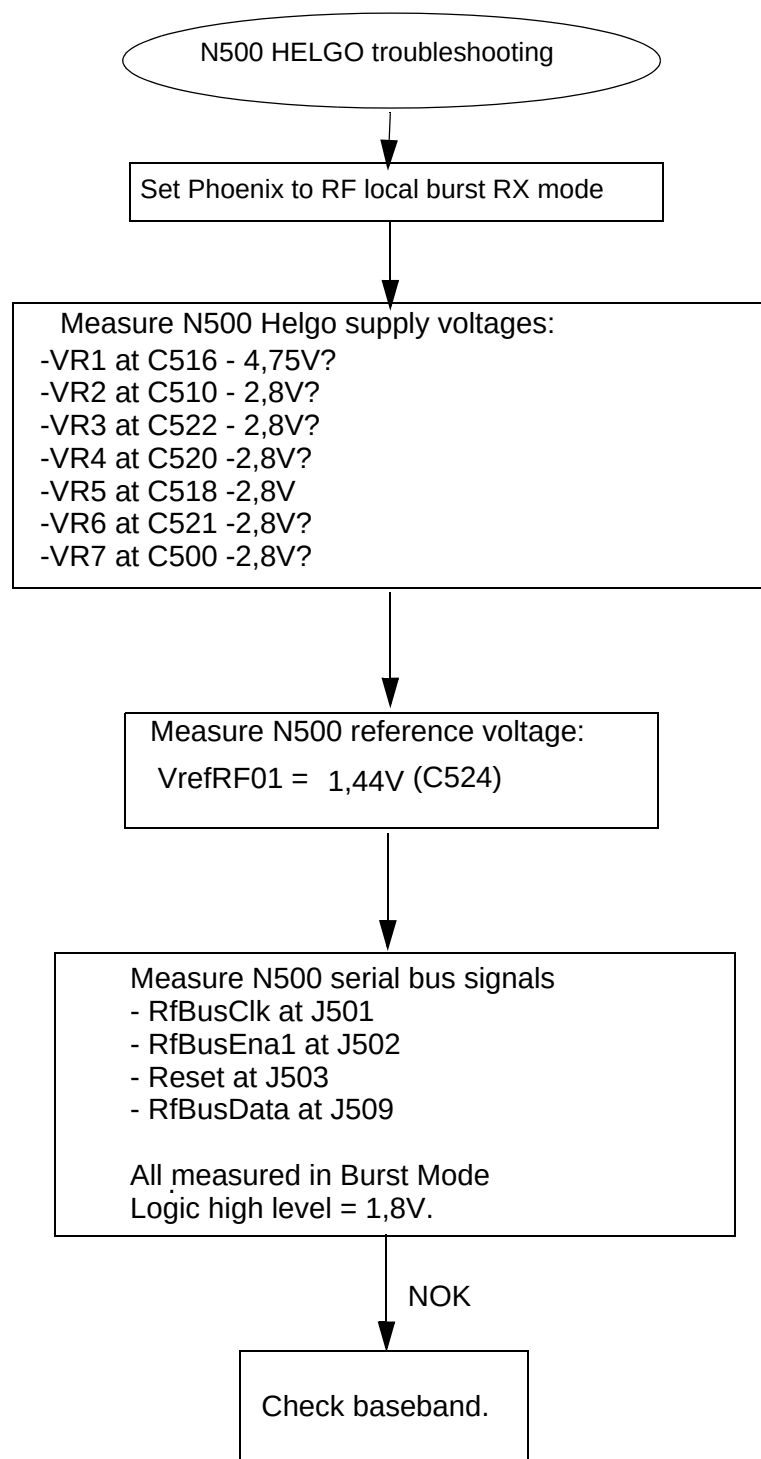
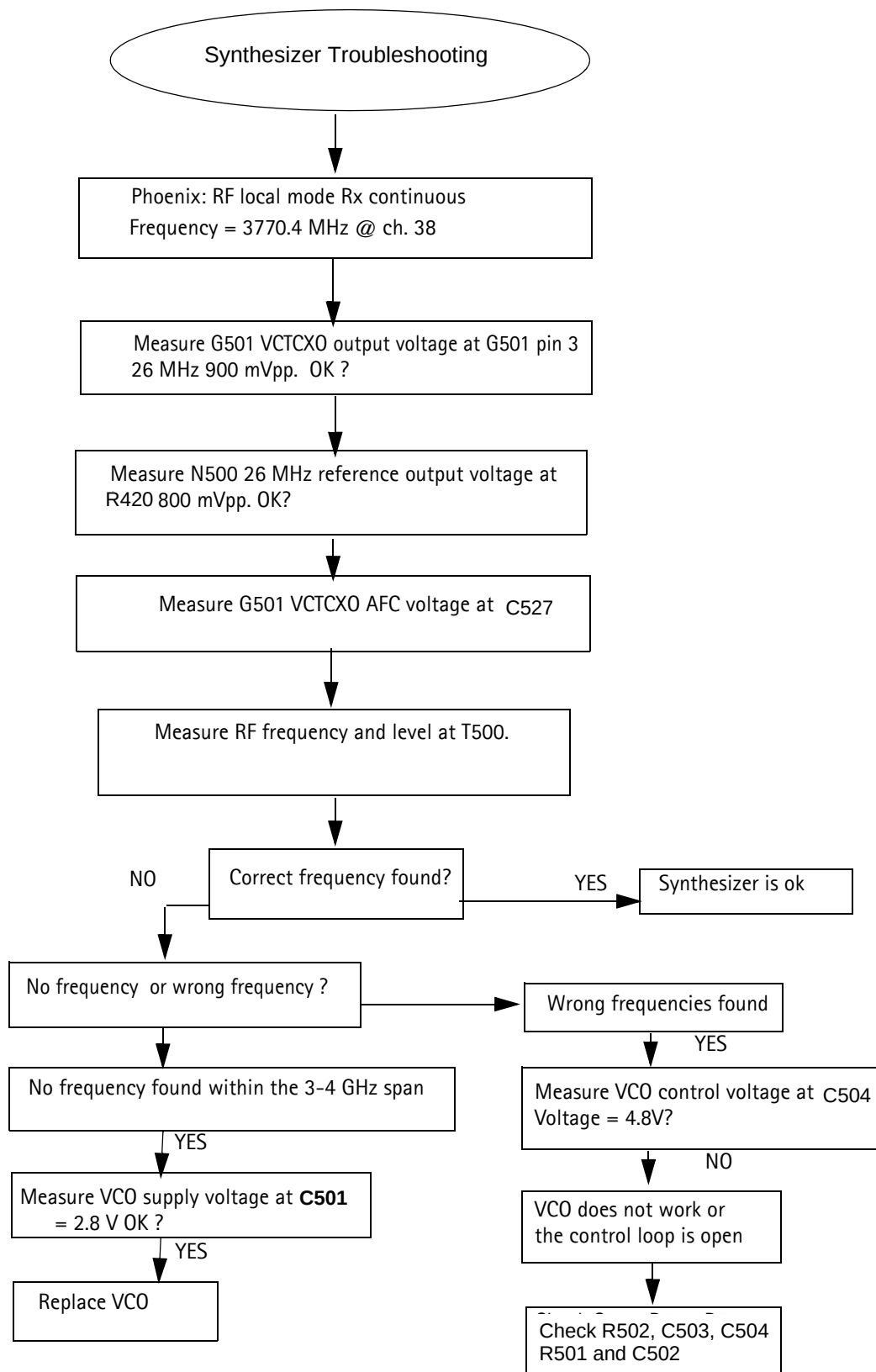


Figure 2:PA/TX



■ N500 Helgo troubleshooting

■ Synthesizer troubleshooting



Tx Troubleshooting

Figure 3: Helgo/Synthesizer

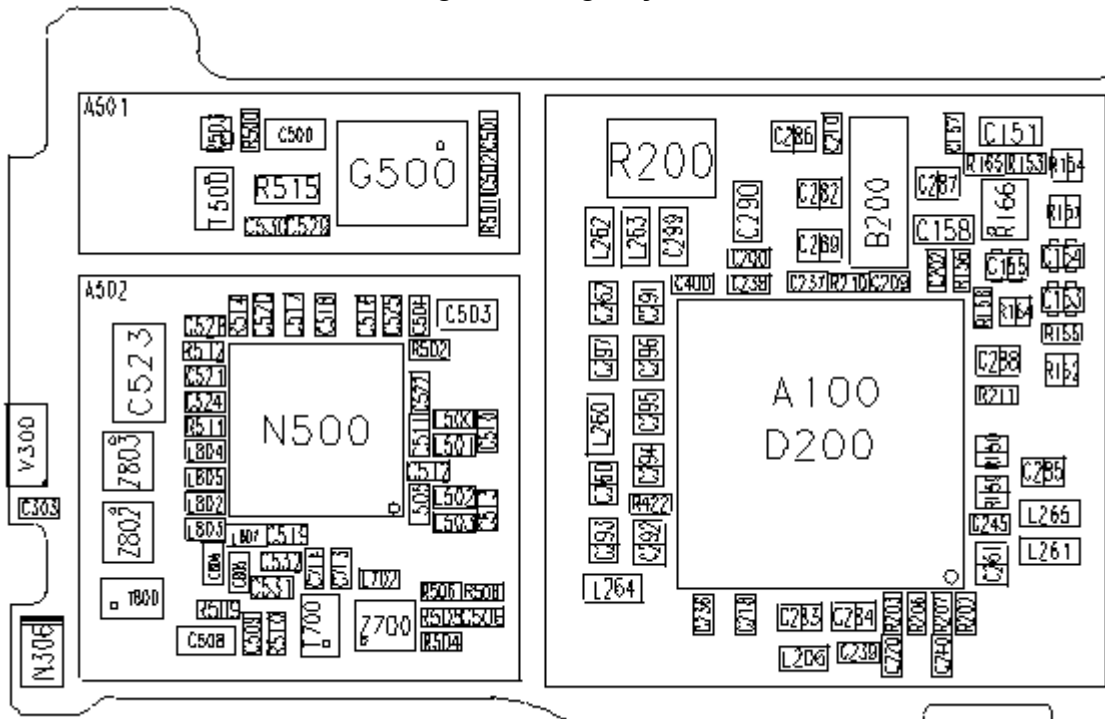
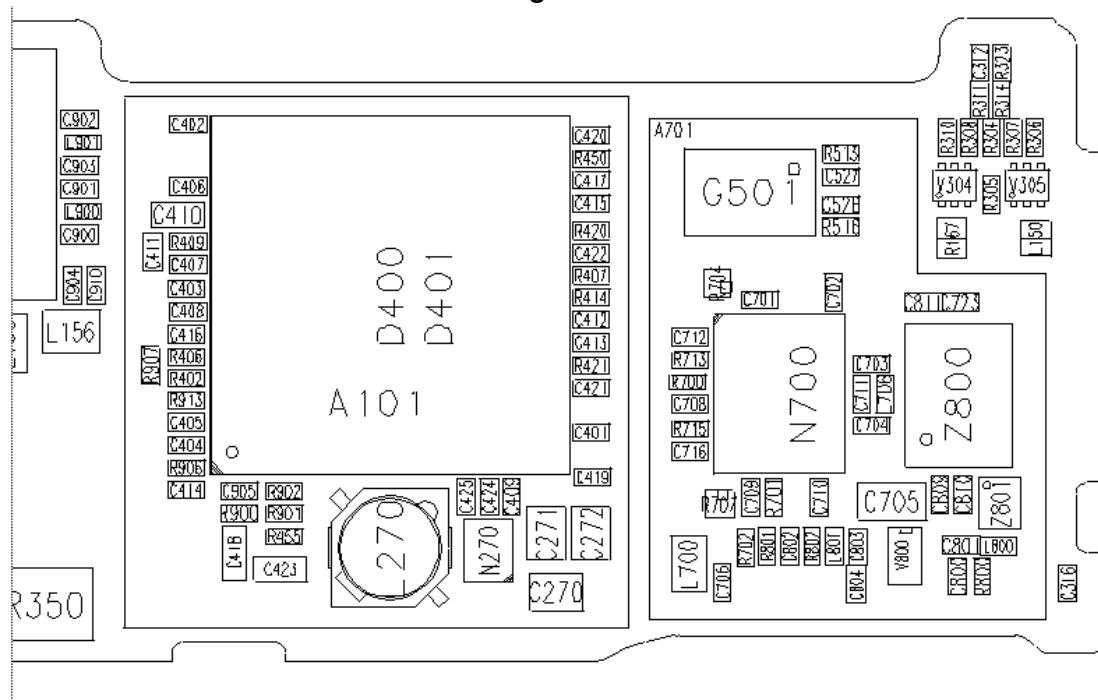
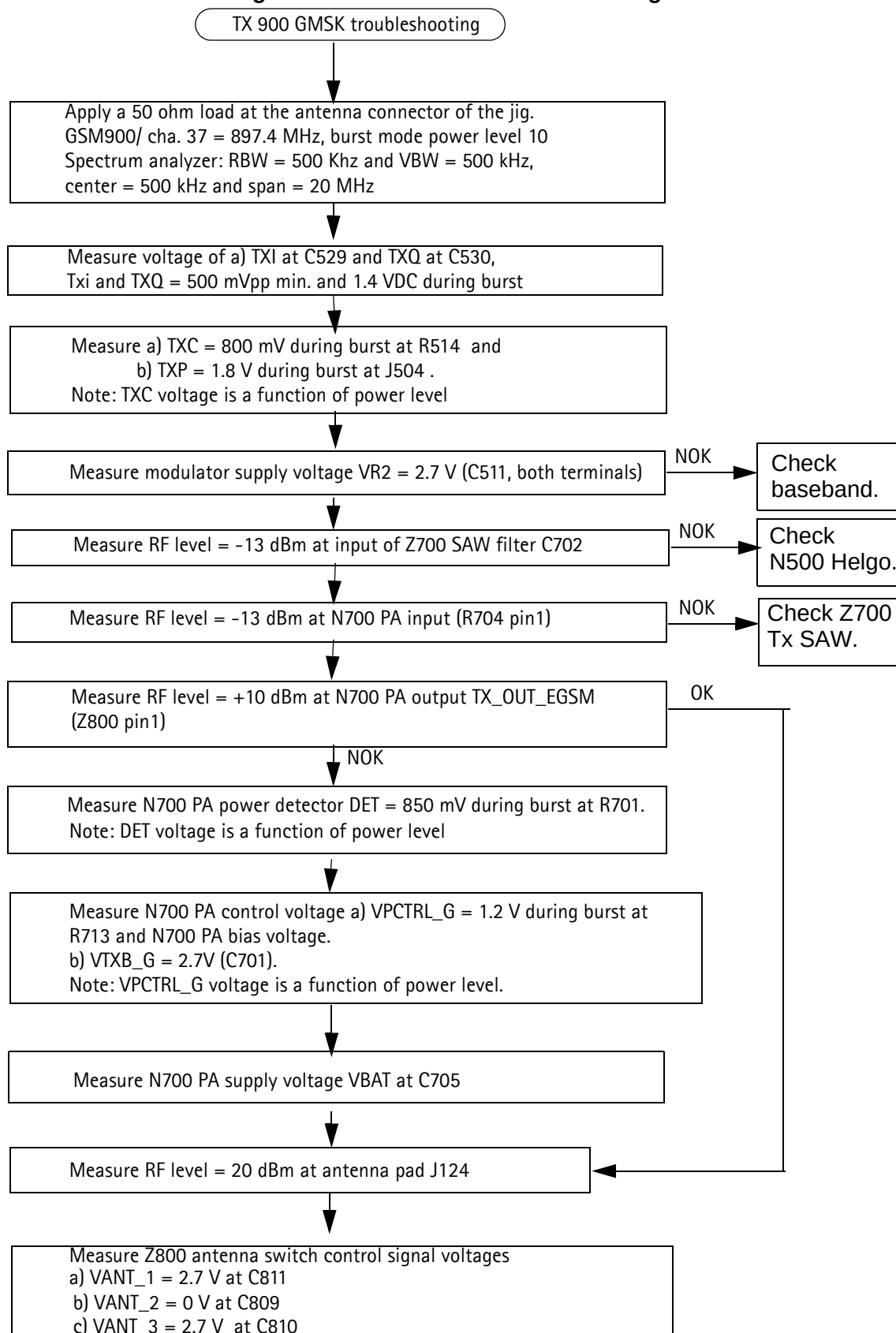


Figure 4:PA/TX



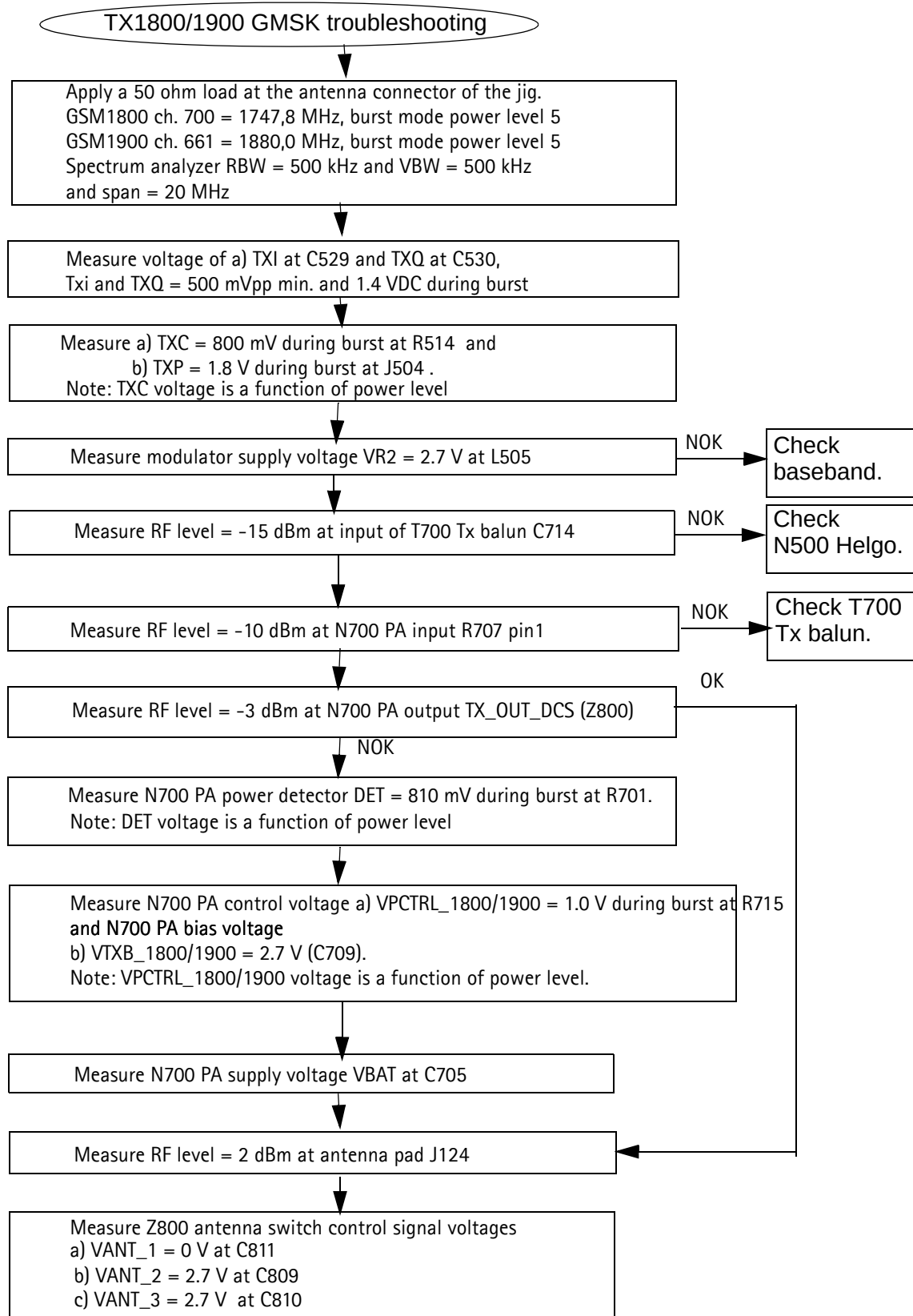
■ Tx 900 GSMK troubleshooting

Figure 5: TX 900 GSMK troubleshooting



■ Tx 1800/1900 GMSK troubleshooting

Figure 6:TX 1800/1900 GMSK troubleshooting



Rx Troubleshooting

Figure 7: Helgo/Synthesizer

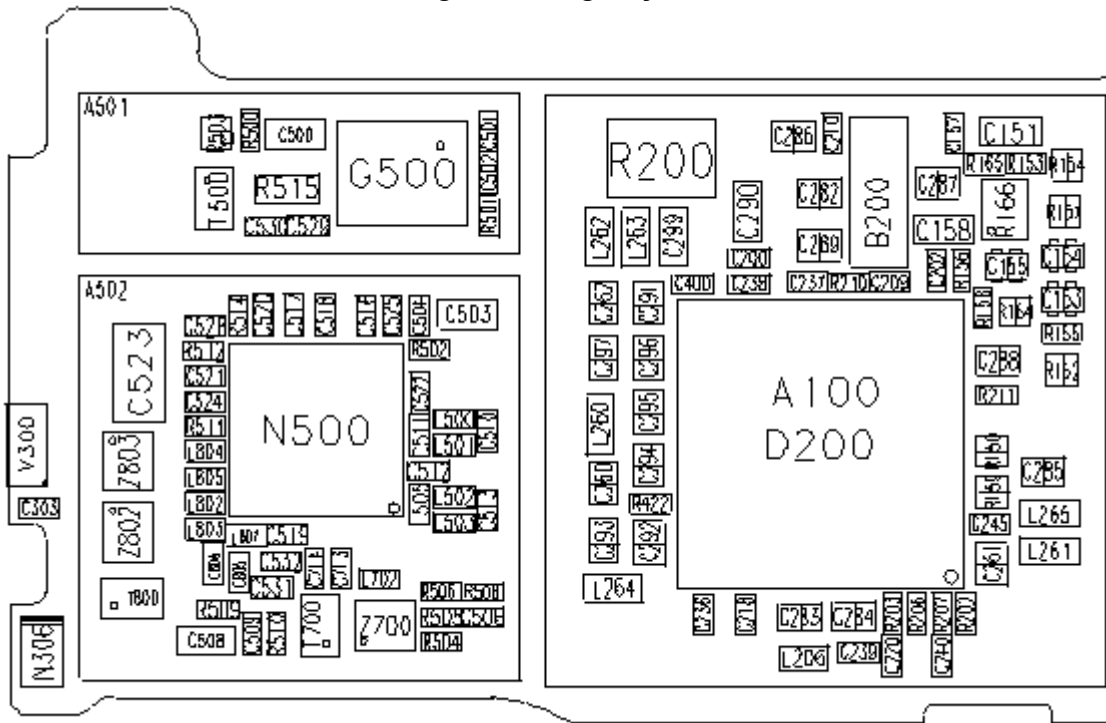
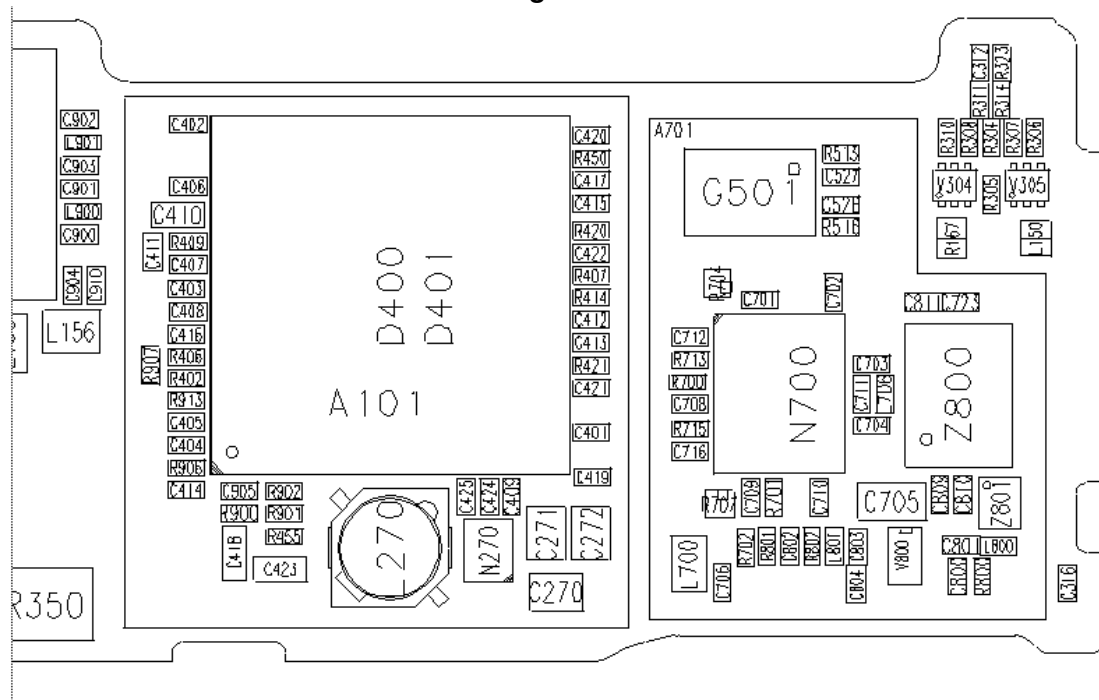
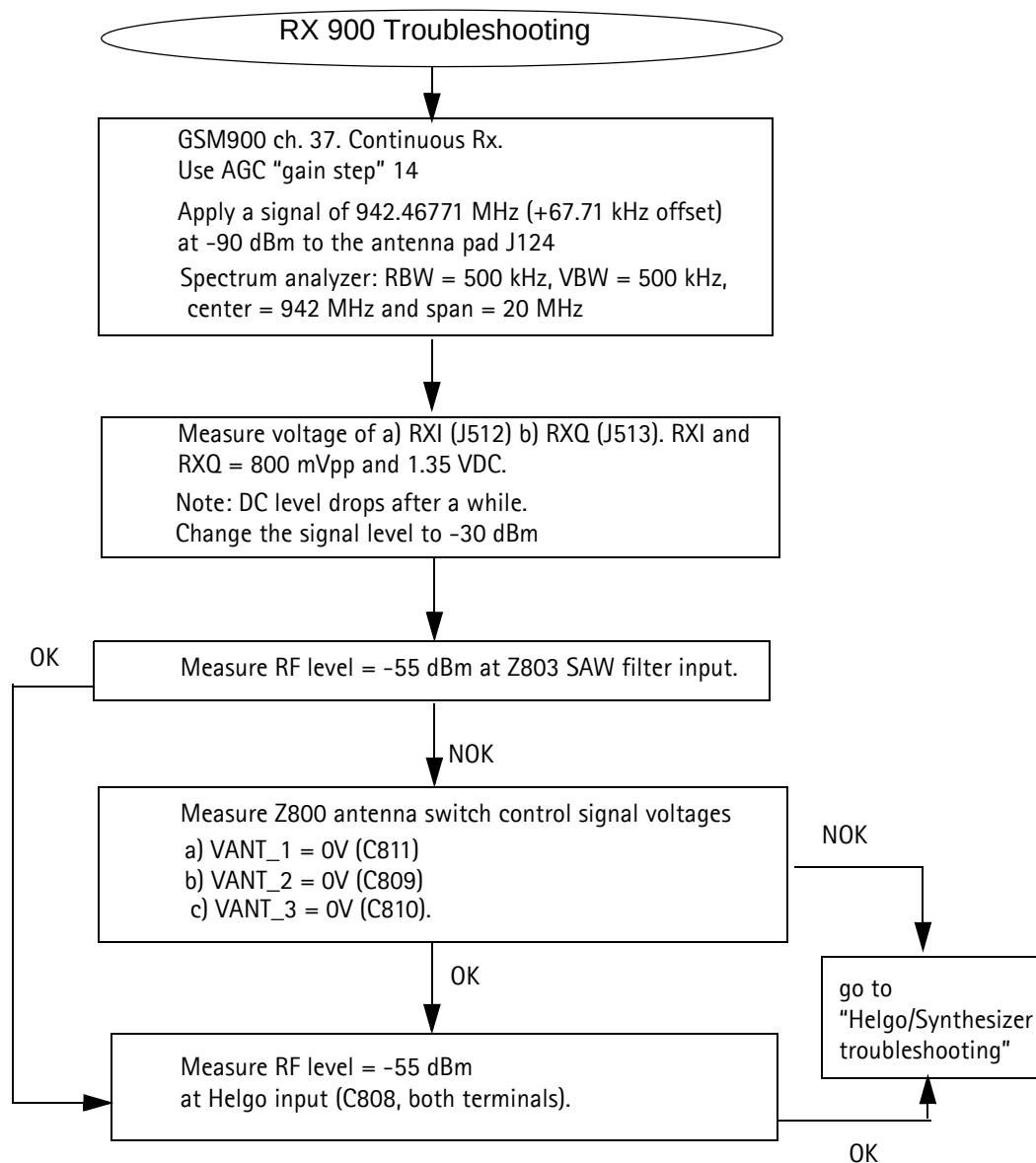


Figure 8:PA/TX



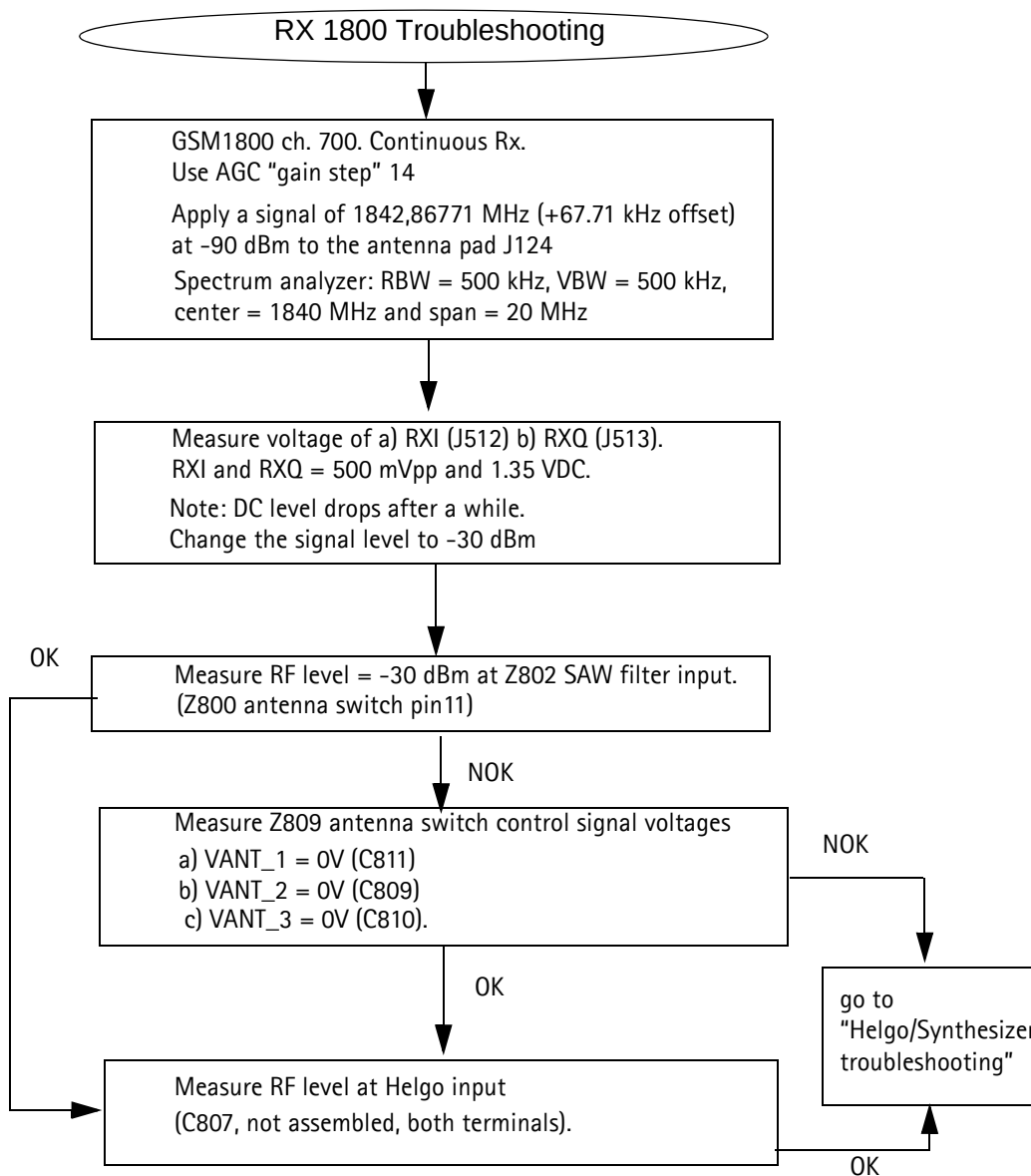
■ Rx 900 troubleshooting

Figure 9:RX 900 troubleshooting



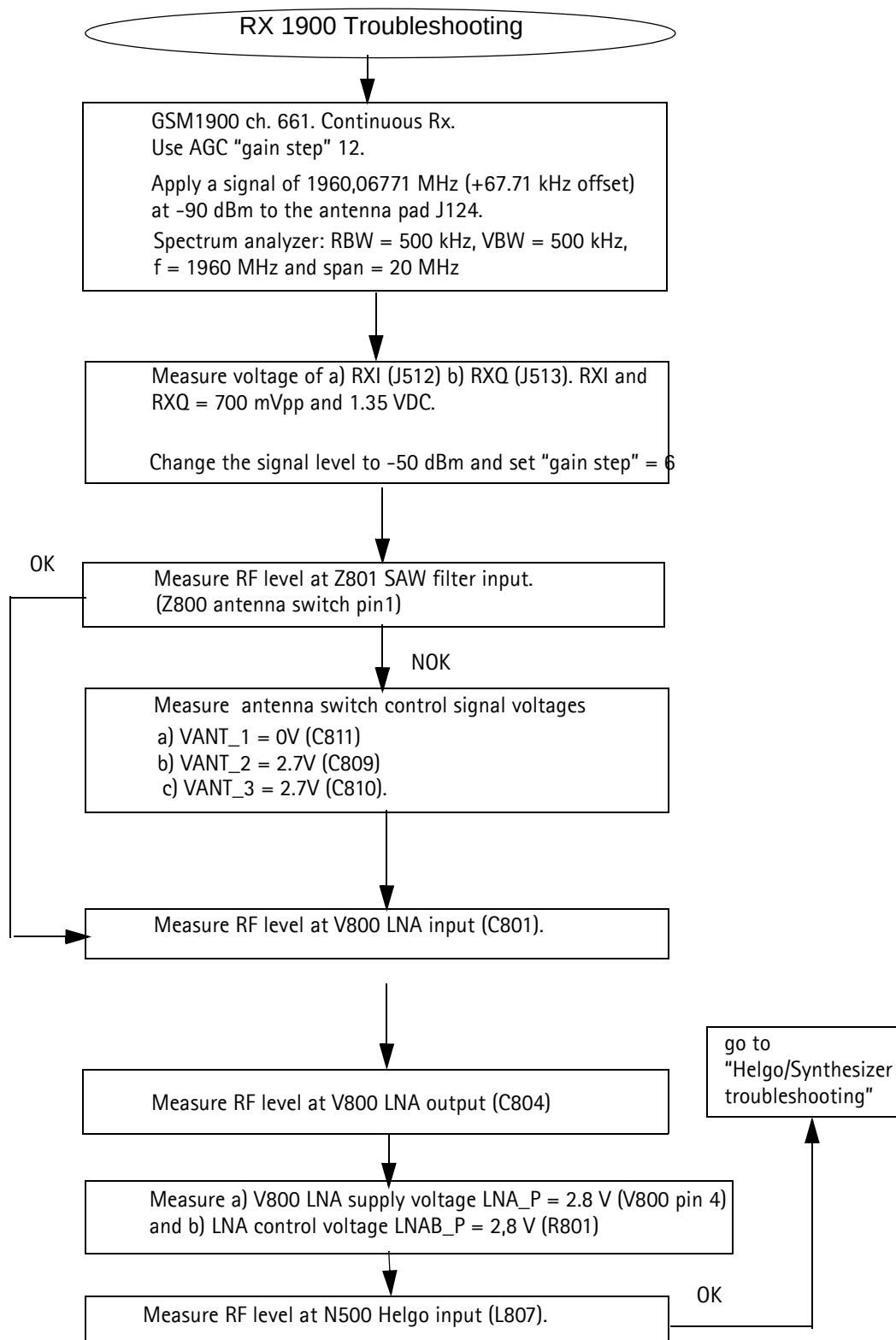
■ Rx 1800 troubleshooting

Figure 10:RX 1800 troubleshooting



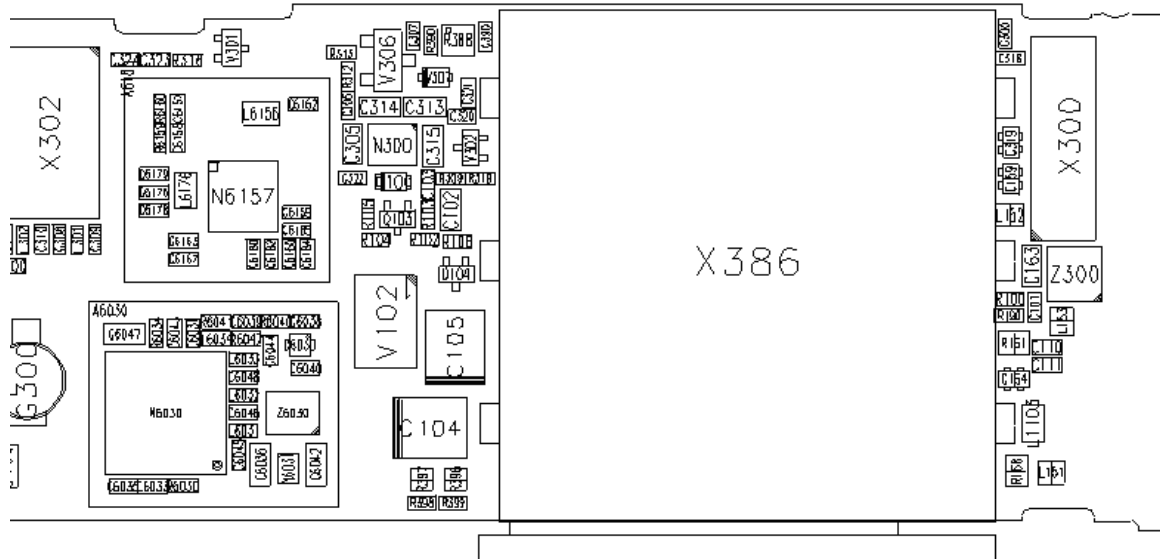
Rx 1900 troubleshooting

Figure 11:RX 1900 troubleshooting



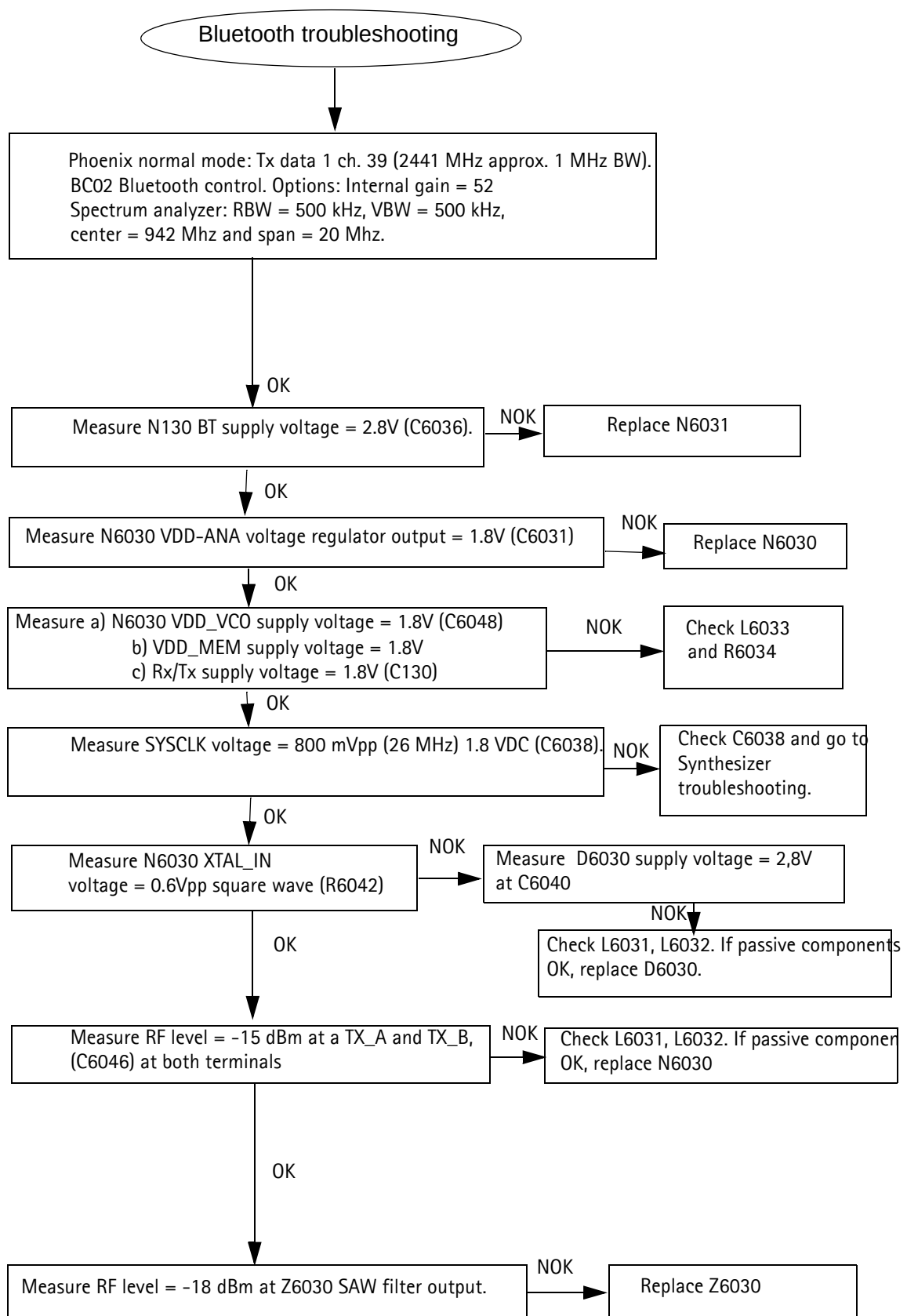
Bluetooth / FM Radio Troubleshooting

Figure 12:Bluetooth/FM



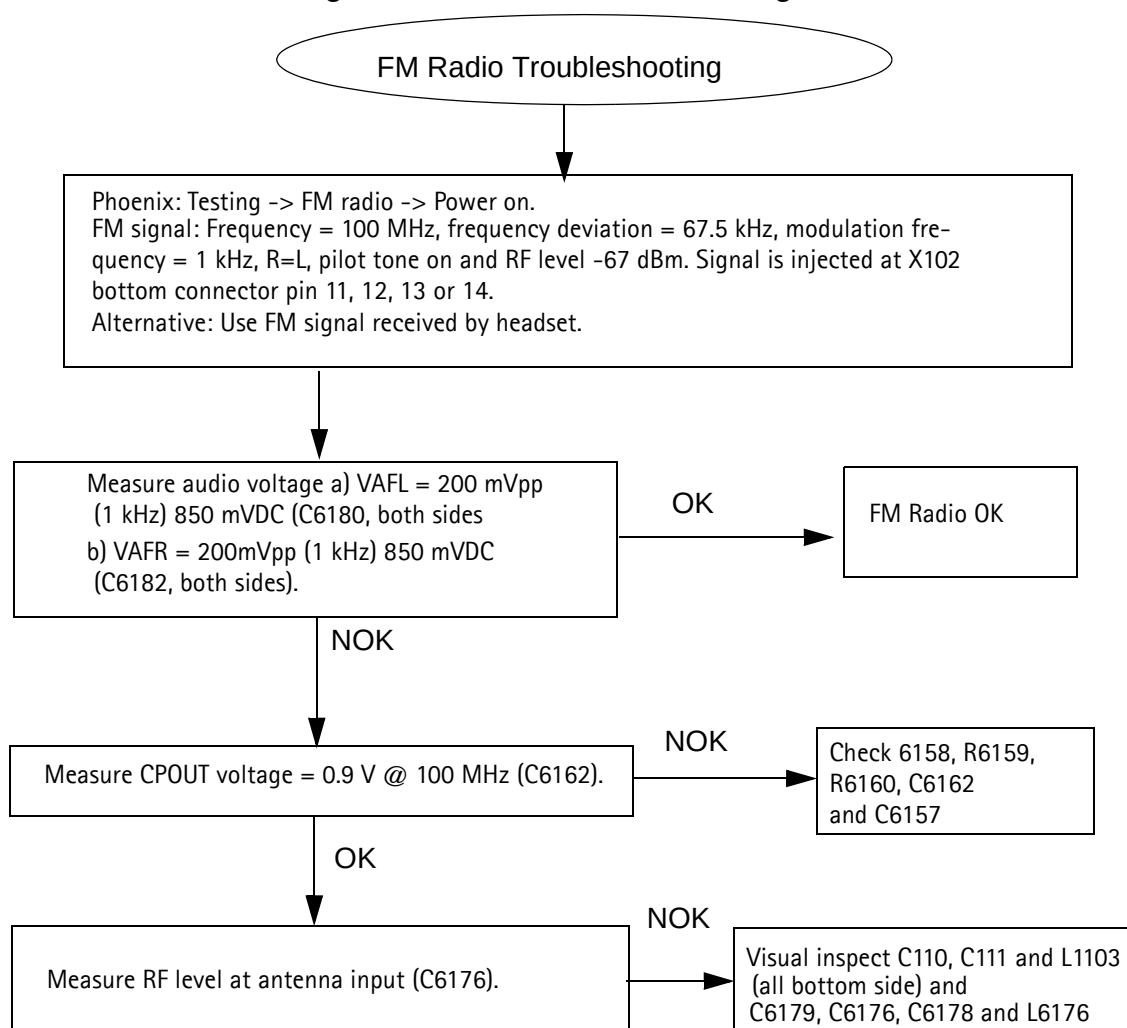
Bluetooth troubleshooting

Figure 13: Bluetooth troubleshooting



■ FM radio troubleshooting

Figure 14:FM radio troubleshooting



Service Tool Concept for RF Tunings

All RF tunings for RM-14 phones must be carried out in MJ-34 Module Jig.

Power to MJ-34 should be supplied from an external DC power supply, not FPS-8 prommer.

MJ-34 input voltages:

- Maximum + 16 VDC
- Nominal input for RF tunings is +12 V DC

Remember cable attenuation when setting required RF levels.

RF tunings should be made in the same order as shown in this document, the order of the corresponding menu items in the Phoenix Service SW may be different.

If baseband tunings are needed, they should be made before the RF tunings.

Avoid unnecessary tuning – factory tuning values are always the most accurate ones.

Views in this document may change as the service software is developed. Please refer to the Phoenix help files, phone model specific service manual and bulletins for help.

■ Service concept for RM-14 RF tunings

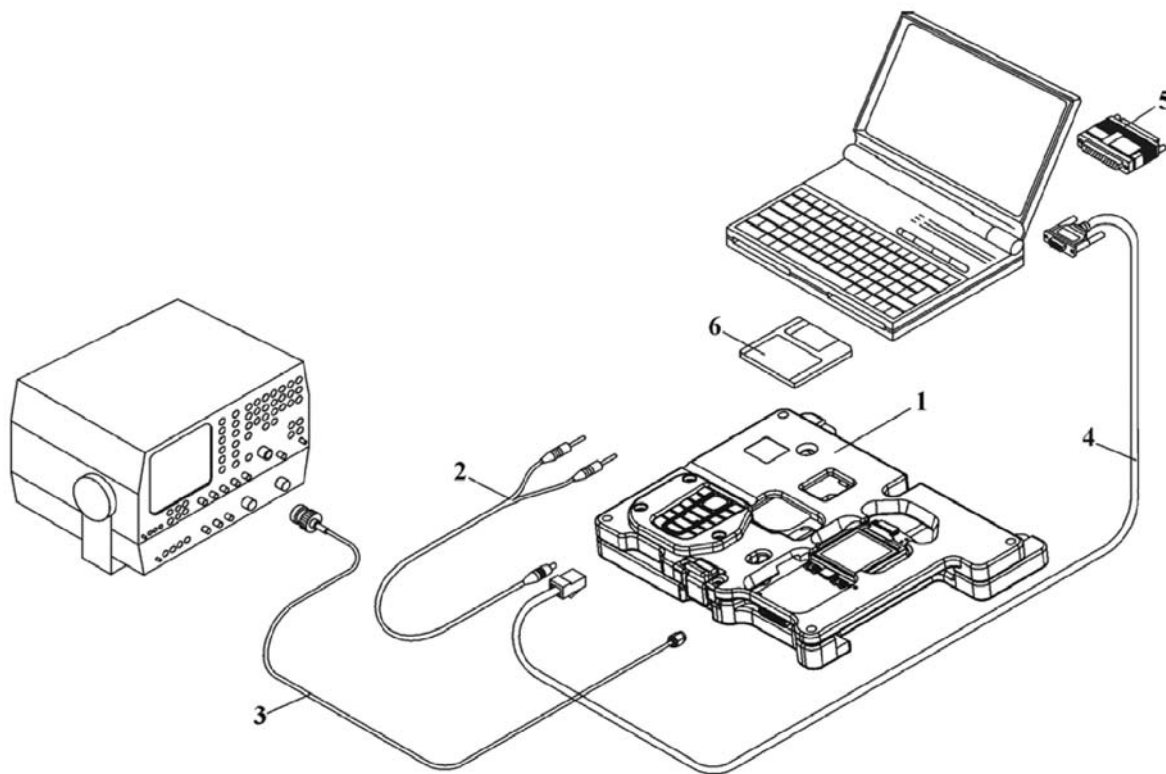


Table 1:

Item	Type	Description	Product code
1	MJ-34	Module jig	0780346
2	PCS-1	DC power cable	0730012
3	XRF-1	Modular cable	0730085
4	DAU-9S	Service MBUS cable	0730108

Receiver Tunings

■ RX channel select filter calibration

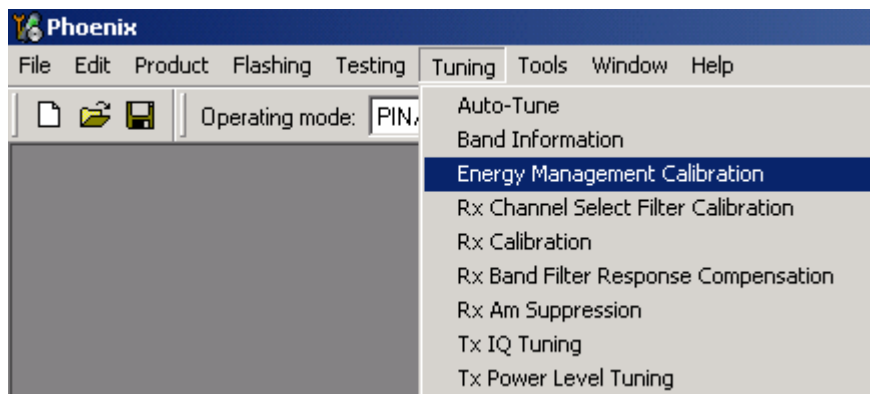
Extra equipment / external RF signal is not needed.

Must be done before other RX calibrations.

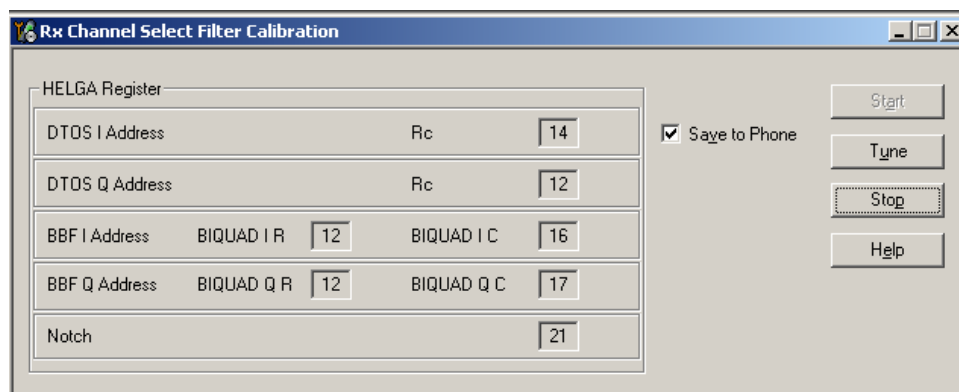
This function is used to calibrate RX channel select filter in GSM Phones.

Rx Channel select filter is tuned only in one (lowest) band = Single calibration for all bands.

Select **Tuning => Rx Channel select filter calibration**.



Press **"Tune"** to start the tuning.



Values will be saved to the phone when the **"Save to Phone"** tick box is checked.

If the **"Save to Phone"** tick box is *not* checked, the values are not saved to the phone when you stop the tuning or exit the dialog.

Tuning values should be 0...31.

Select **"Stop"**.

Close the **"RX Channel Select Filter Calibration"** dialog to end tuning.

■ RX calibration

RF generator is needed.

This tuning performs RX Calibration.

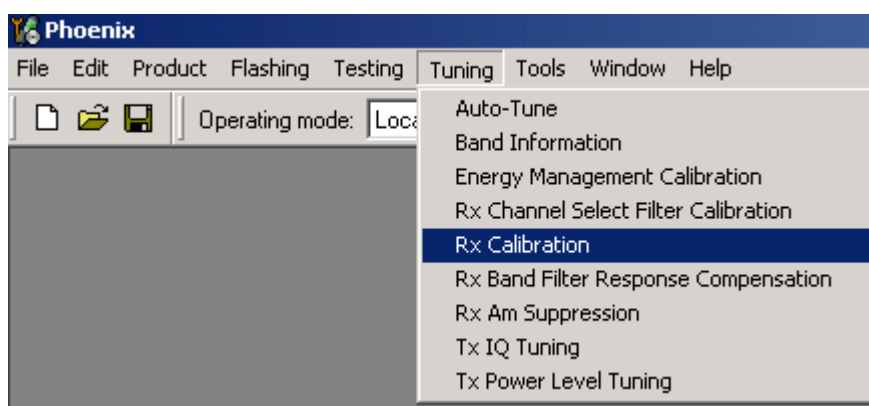
Must be done separately on all bands!

Calibration is automatically performed at EGSM (GSM900), then at GSM1800 and finally at the GSM1900 band. If the tuning is successful, it continues in the next band.

AFC tuning is carried out while EGSM (GSM900) band RX Calibration is performed.

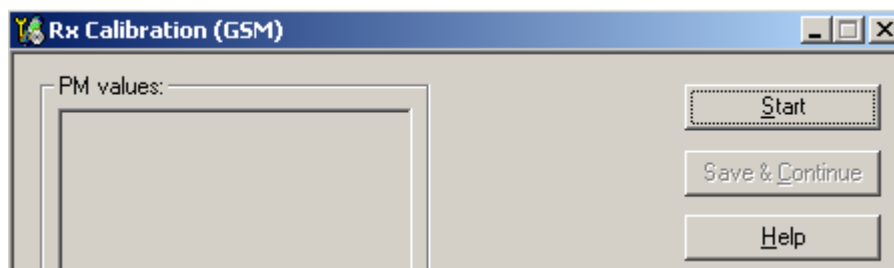
Remember to take jig and cable attenuations into account!

Select **Tuning => Rx calibration**

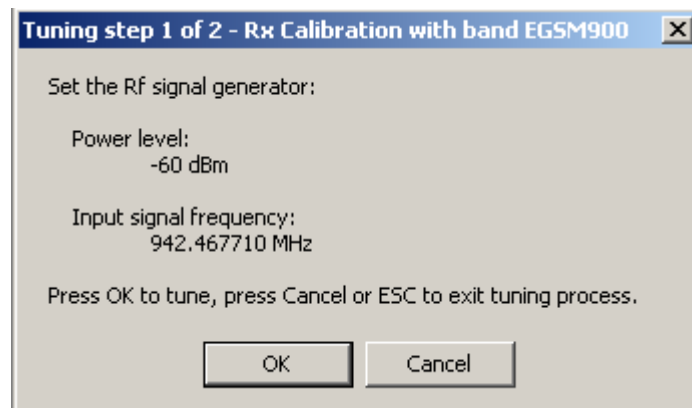


EGSM900 band

Press "**Start**" to begin.



Set RF generator to required EGSM900 frequency => OK



Tuning values and ADC readings will be shown

Typical values and limits in (GSM900) RX Calibration:

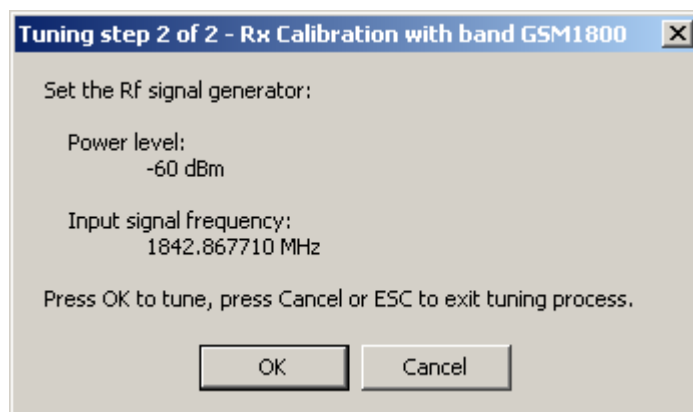
Table 2:

GSM900	Typical value	Low limit	High limit
AFC value	0	-350	350
AFC slope	150	50	350
RSSI 0	68	58	78
RSSI 1	74	64	84
RSSI 2	80	70	90
RSSI 3	86	76	96
RSSI 4	92	82	102
RSSI 5	97	87	107
RSSI 6	103	93	113
RSSI 7	109	99	119
RSSI 8	115	105	125
RSSI 9	121	111	131
RSSI 10	127	117	137
RSSI 11	133	123	143
RSSI 12	139	129	149
RSSI 13	145	135	155
RSSI 14	151	141	161

Tuning will automatically move to the next band (GSM1800) when you press **"Save & Continue"**.

GSM1800 band

When asked, set the RF generator to required GSM1800 frequency => **OK**



Tuning values and ADC readings will be shown.

Typical values and limits in (GSM1800) RX Calibration:

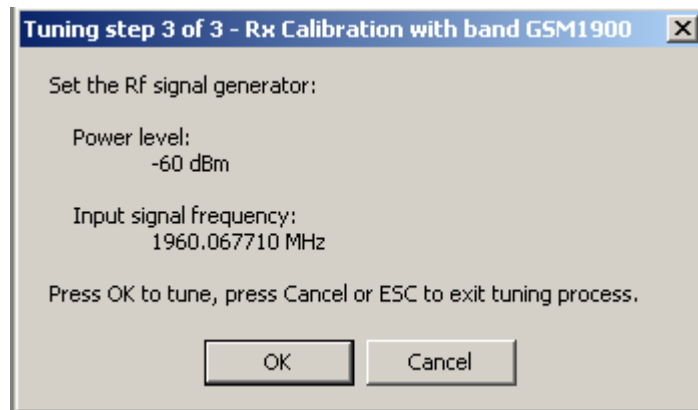
Table 3:

GSM1800	Typical value	Low limit	High limit
RSSI 0	65	55	75
RSSI 1	71	61	81
RSSI 2	77	67	87
RSSI 3	83	73	93
RSSI 4	89	79	99
RSSI 5	94	84	104
RSSI 6	100	90	110
RSSI 7	106	96	116
RSSI 8	112	102	122
RSSI 9	118	108	128
RSSI 10	124	114	134
RSSI 11	130	120	140
RSSI 12	136	126	146
RSSI 13	142	132	152
RSSI 14	148	138	158

Tuning will automatically move to the next band (GSM1900) when you press “**Save & Continue**”

GSM1900 band

Set RF generator to required GSM1900 frequency => OK



Tuning values and ADC readings will be shown

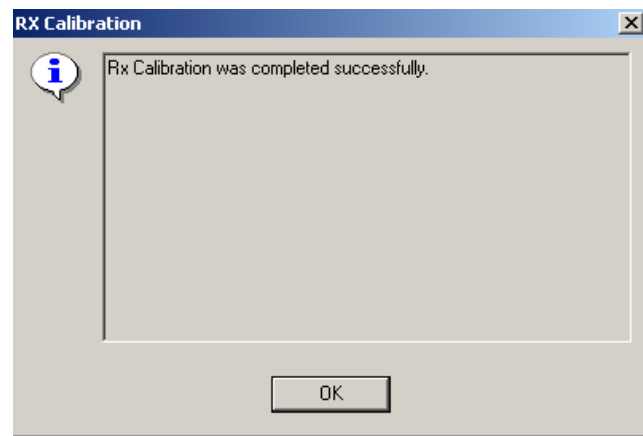
Typical values and limits in (GSM1900) RX Calibration:

Table 4:

GSM1900	Typical value	Low limit	High limit
RSSI 0	67	57	77
RSSI 1	73	63	83
RSSI 2	79	69	89
RSSI 3	85	75	95
RSSI 4	91	81	101
RSSI 5	98	88	108
RSSI 6	104	94	114
RSSI 7	110	100	120
RSSI 8	116	106	126
RSSI 9	122	112	132
RSSI 10	128	118	138
RSSI 11	134	124	144
RSSI 12	140	130	150
RSSI 13	146	136	156
RSSI 14	152	142	162

Tuning will be completed when you press **“Save & Continue”**.

Close the **“RX – Calibration”** dialog to end tuning.



■ RX band filter response compensation

RF generator needed.

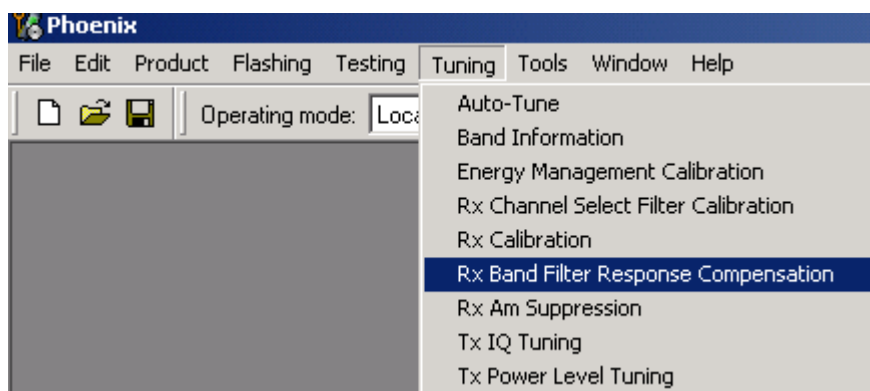
Must be performed separately on all bands!

Start the RX calibration at EGSM (GSM900), then continue to the GSM1800 band and finally to the GSM1900 band.

Remember to carry out the RX calibration before carrying out Rx band filter response compensation!

Remember to take jig and cable attenuations into account!

Select **Tuning => Rx Band Filter Response Compensation**



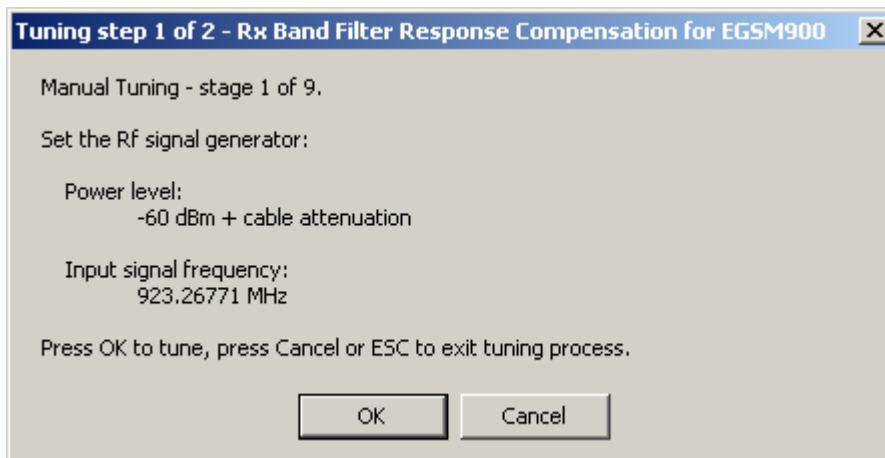
Select **“Manual tuning”** and **“Start”**.

You will be asked to supply 9 different RF frequencies to the phone on each band.

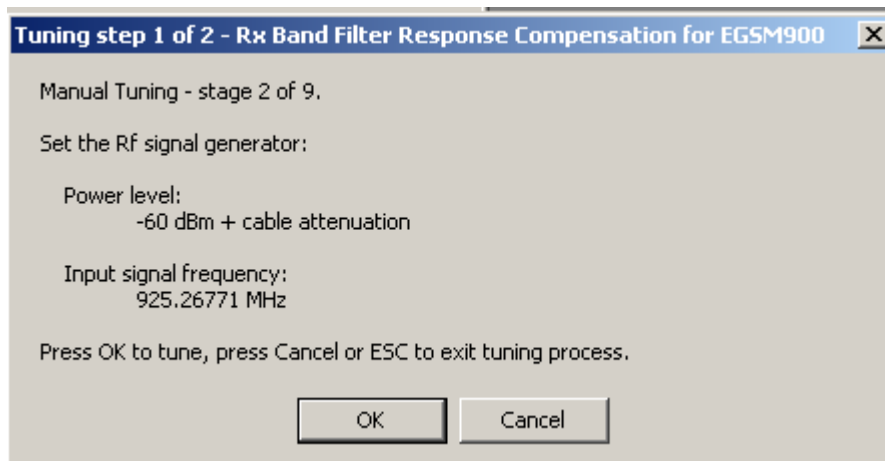
The tuning begins from EGSM900 band and continues the same way for GSM1800 and GSM1900 bands.

EGSM900 band

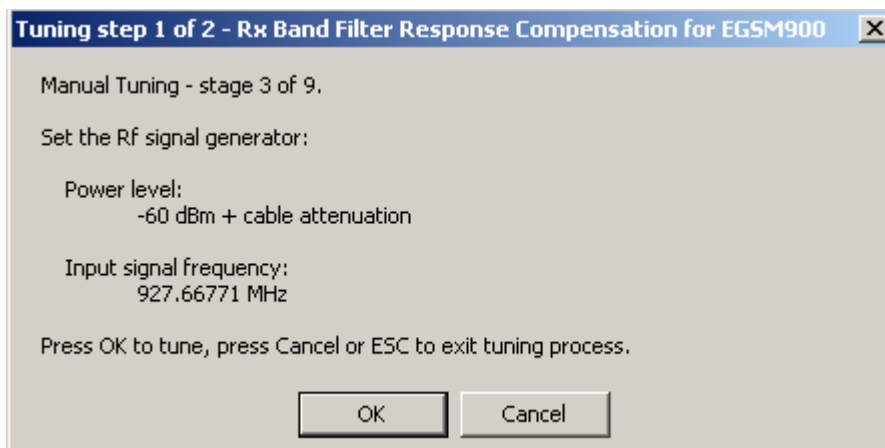
Set first required frequency and level => OK



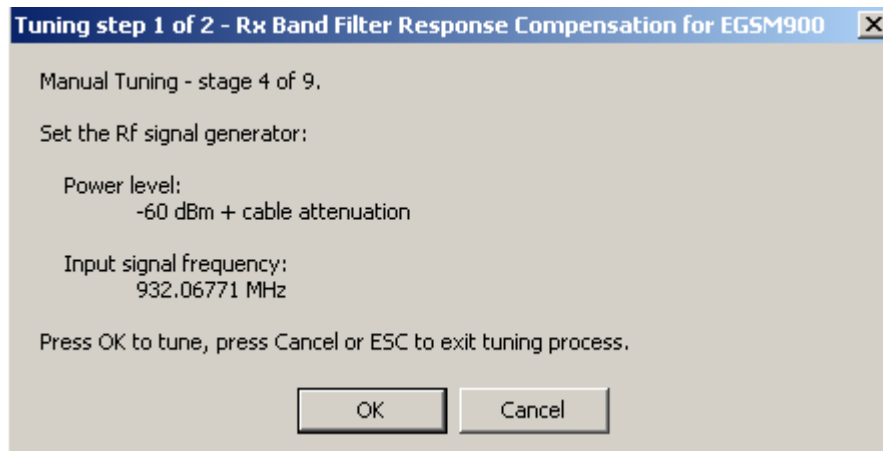
Set 2nd required frequency and level => **OK**



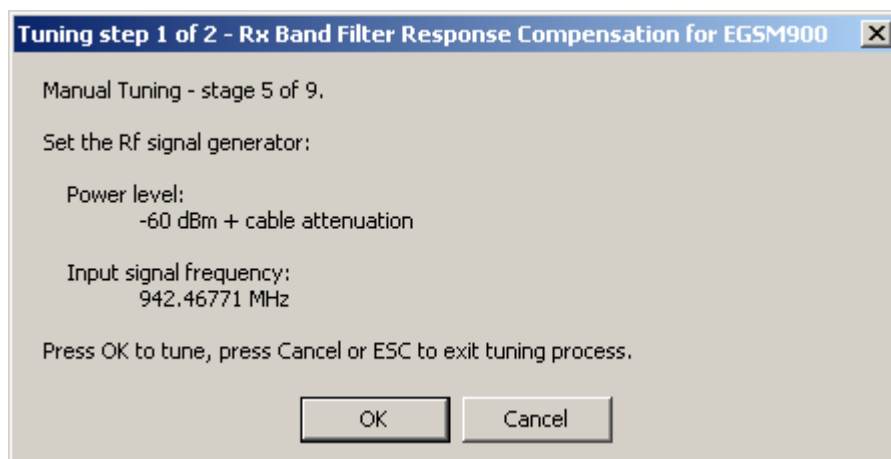
Set 3rd required frequency and level => **OK**



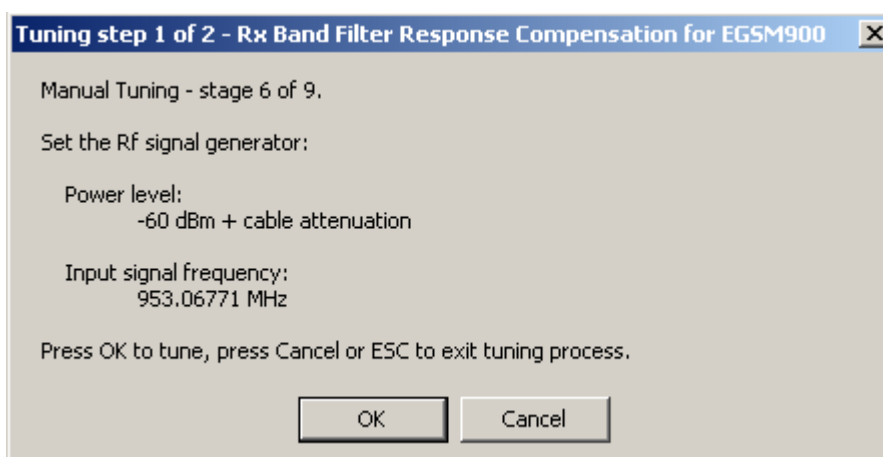
Set 4th required frequency and level => **OK**



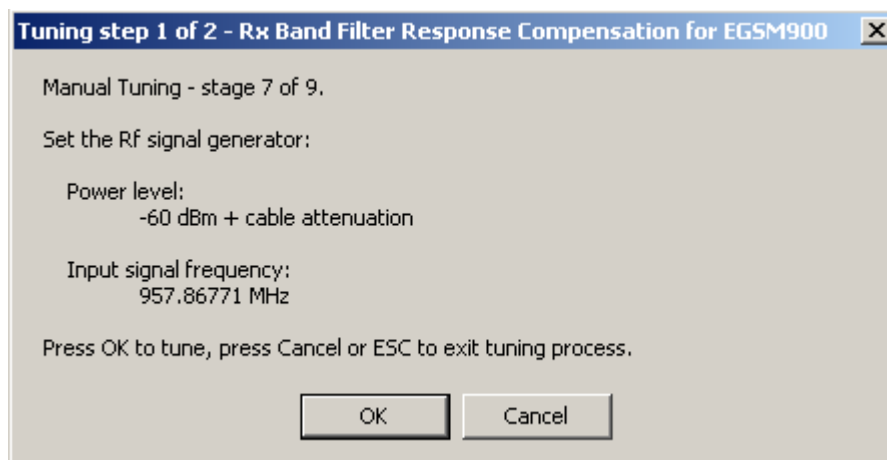
Set 5th required frequency and level => **OK**



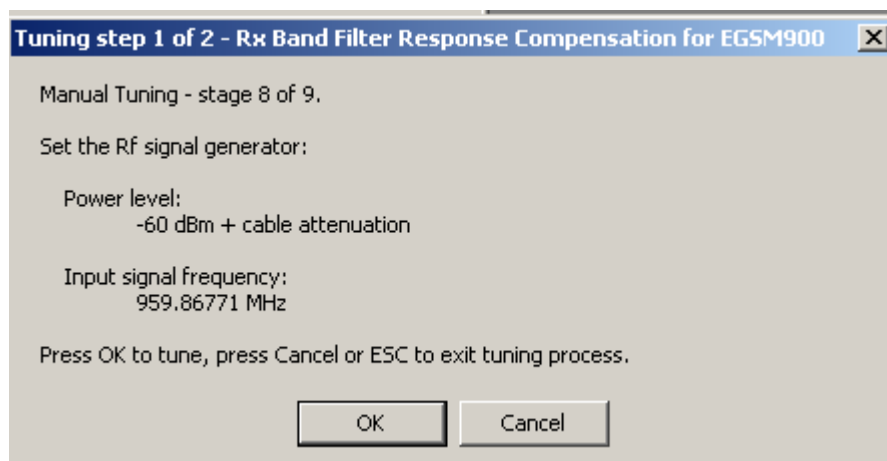
Set 6th required frequency and level => **OK**



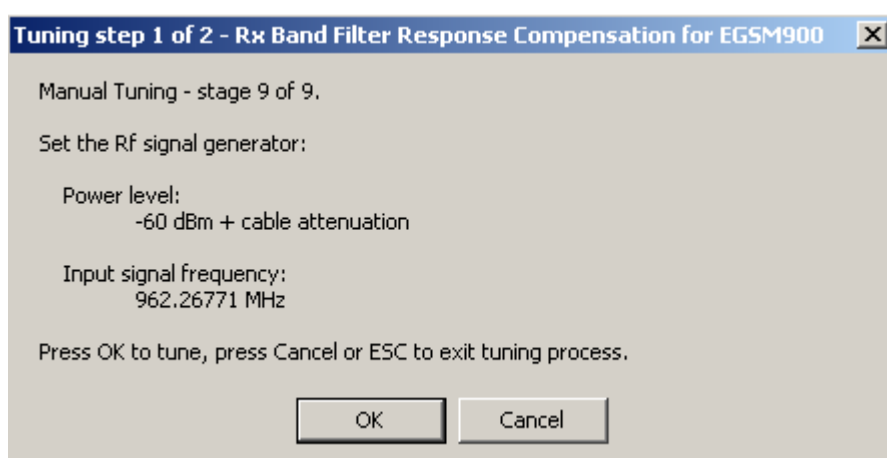
Set 7th required frequency and level => **OK**



Set 8th required frequency and level => **OK**



Set 9th required frequency and level => **OK**



Tuning values and ADC readings will be shown.

Typical values and limits in Rx Band Filter Response Compensation EGSM900:

Table 5:

Channel	Input frequency [MHz]	Typical value [dB]	Low limit [dB]	High limit [dB]
965	923.26771	+3	-10	5
975	925.26771	+1	-5	5
987	927.66771	+1	-5	5
1009	932.06771	+1	-5	5
37	942.46771	+1	-5	5
90	953.06771	+1	-5	5
114	957.86771	+1	-5	5
124	959.86771	+1	-5	5
136	962.26771	+3	-10	5

Tuning will automatically move to the next band (GSM1800) when you press **“Save & Continue”**.

GSM1800 band

Repeat the same steps as for the EGSM900 band above.

Typical values and limits in Rx Band Filter Response Compensation GSM1800:

Table 6:

Channel	Input frequency [MHz]	Typical value [dB]	Low limit [dB]	High limit [dB]
497	1802.26771	+3	-10	5
512	1805.26771	+1	-5	5
535	1809.86771	+1	-5	5
606	1824.06771	+1	-5	5
700	1842.86771	+1	-5	5
791	1861.06771	+1	-5	5

Table 6:

870	1876.8677 1	+ -1	-5	5
885	1879.8677 1	+ -1	-5	5
908	1884.4677 1	+ -3	-10	5

Tuning will automatically move to the next band (GSM1900) when you press **“Save & Continue”**.

GSM1900 band

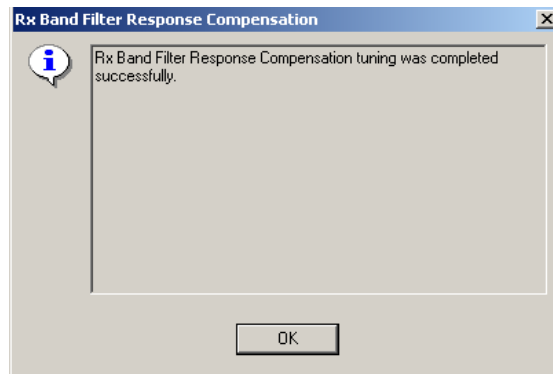
Repeat the same steps as for the EGSM900 and GSM1800 bands above.

Typical values and limits in Rx Band Filter Response Compensation GSM1900:

Table 7:

Channel	Input frequency [MHz]	Typical value [dB]	Low limit [dB]	High limit [dB]
496	1927.0677 1	+ -3	-10	5
512	1930.2677 1	+ -1	-5	5
537	1935.2677 1	+ -1	-5	5
586	1945.0677 1	+ -1	-5	5
661	1960.0677 1	+ -1	-5	5
736	1975.0677 1	+ -1	-5	5
794	1986.6677 1	+ -1	-5	5
810	1989.8677 1	+ -1	-5	5
835	1994.8677 1	+ -3	-10	5

Tuning will be completed when you press **“Save & Continue”**.



Close the “RX Band Filter Response Compensation” dialog to end tuning.

Transmitter Tunings

■ TX power level tuning

Power Meter (or Spectrum analyzer) is needed.

With Tx power level tuning, the coefficients are adjusted for each power level.

Tuning must be performed separately on all band and all modes!

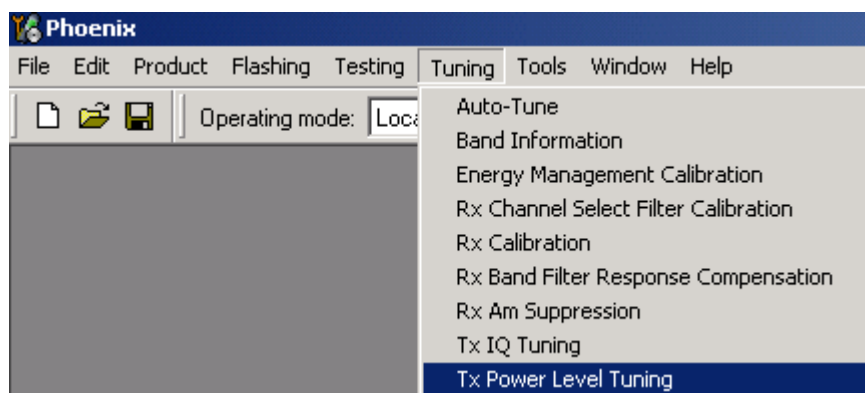
When EDGE is on, the tuning must be carried out for all power levels.

Tx power level tuning steps are:

- EGSM900 PA High Mode with EDGE off
- EGSM900 PA High Mode with EDGE on
- GSM1800 PA High Mode with EDGE off
- GSM1800 PA High Mode with EDGE on
- GSM1900 PA High Mode with EDGE off
- GSM1900 PA High Mode with EDGE on

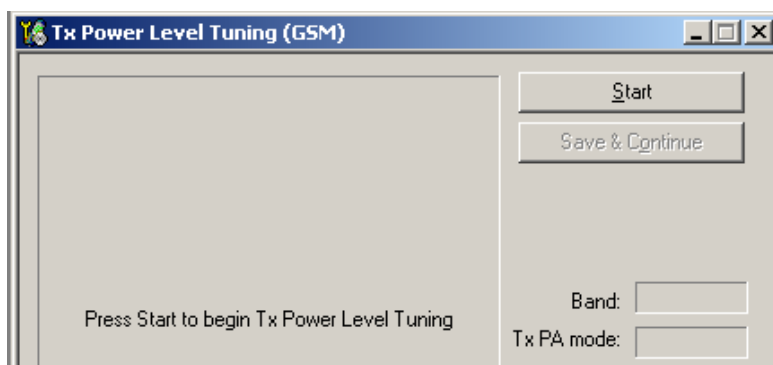
Select **Tuning => Tx power level tuning**

Remember to take jig and cable attenuations into account!

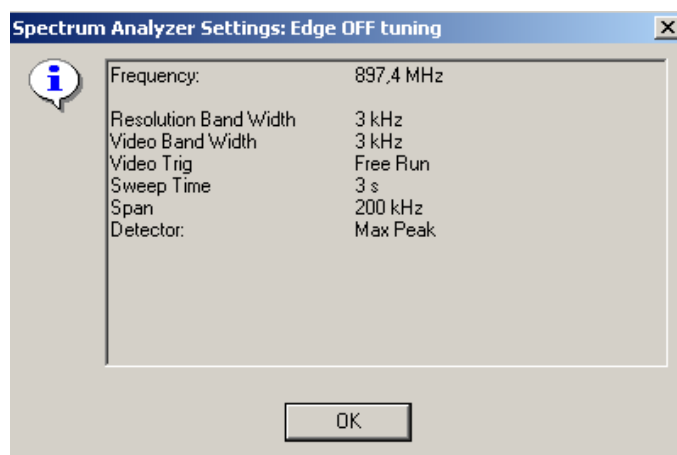


EGSM900 PA High Mode with EDGE off

Select "Start", the tuning begins automatically from the EGSM900 band.



Set Power Meter (or Spectrum analyzer) as required.



Note that TX PA mode is "High" at this point.

The coefficient table lists the power level, coefficient, target dBm and DAC value for each power level.

The tuned power level can be chosen by using up and down arrows or mouse.

The current power level is shown with inverse colors.

The tuning value can be adjusted with "-" and "+" keys.

Tune **base level** and power levels **19,15** and **5** to target level.

	Coefficient	Target dBm
5	0.7658	32.0
6	0.7062	31.0
7	0.6050	29.0
8	0.5231	27.0
9	0.4566	25.0
10	0.4022	23.0
11	0.3576	21.0
12	0.3210	19.0
13	0.2908	17.0
14	0.2659	15.0
15	0.2454	13.0
16	0.2287	11.0
17	0.2150	9.0
18	0.2041	7.0
19	0.1955	5.0
Base	0.1554	-30.0
Test	0.1554	

Start
Save & Continue

Band: GSM 900
Tx PA mode: High

Tx channel: 37
Frequency: 897.40 MHz

Help

When tuning values are correct, choose “**Save & Continue**”.

If all coefficients are within specified limits, tuning will continue on the EGSM900 PA Low Mode with EDGE off.

Typical values:

Table 8:

Power level	GSM900 EDGE off
5	0.650 ... 0.850
15	0.140 ... 0.200
19	0.120 ... 0.170
Base	0.090 ... 0.130

EGSM900 PA high mode with EDGE on

Set Power Meter (or Spectrum analyzer) as required.

Repeat the same steps as for EGSM high and low mode above.

When EDGE is on, the tuning must be made for all power levels.

Tune **base level** and all power levels from **19** to **8** to target level.

When tuning values are correct, choose “**Save & Continue**”.

If all coefficients are within specified limits, tuning will continue on the EGSM900 PA low mode with EDGE on.

Typical values:

Table 9:

Power level	GSM900 EDGE on
8	0.500 ... 0.650
9	0.400 ... 0.550
10	0.350 ... 0.500
11	0.320 ... 0.470
12	0.300 ... 0.440
13	0.280 ... 0.400
14	0.250 ... 0.350
15	0.230 ... 0.330
16	0.210 ... 0.310
17	0.200 ... 0.300
18	0.190 ... 0.290
19	0.180 ... 0.280
Base	0.100 ... 0.180

GSM1800 PA high mode with EDGE off

Set Power Meter (or Spectrum analyzer) as required.

Repeat the same steps as for EGSM high and low mode above.

Tune base level and power levels 15,11 and 0 to target level.

When tuning values are correct, choose **“Save & Continue”**.

If all coefficients are within specified limits, tuning will continue on the GSM1800 PA high mode with EDGE on.

Typical values:

Table 10:

Power level	GSM1800 EDGE off
0	0.600 ... 0.750
11	0.130 ... 0.190
15	0.110 ... 0.150
Base	0.090 ... 0.130

GSM1800 PA high mode with EDGE on

Set Power Meter (or Spectrum analyzer) as required.

Repeat the same steps as for EGSM high and low mode above.

When EDGE is on, the tuning must be made for all power levels.

Tune base level and all power levels from 15 to 2 to target level.

When tuning values are correct, choose **"Save & Continue"**.

If all coefficients are within specified limits, tuning will continue on the GSM1900 PA high mode with EDGE off.

Typical values:

Table 11:

Power level	GSM1800 EDGE on
2	0.550 ... 0.700
3	0.470 ... 0.620
4	0.400 ... 0.550
5	0.350 ... 0.500
6	0.320 ... 0.470
7	0.290 ... 0.430
8	0.260 ... 0.360
9	0.240 ... 0.330
10	0.220 ... 0.310
11	0.210 ... 0.300
12	0.200 ... 0.280
13	0.180 ... 0.260
14	0.170 ... 0.250
15	0.160 ... 0.240
Base	0.090 ... 0.160

GSM1900 PA high mode with EDGE off

Set Power Meter (or Spectrum analyzer) as required.

Repeat the same steps as for EGSM high and low mode above.

Tune base level and power levels 15,11 and 0 to target level.

When tuning values are correct, choose “**Save & Continue**”.

If all coefficients are within specified limits, tuning will continue on the GSM1900 PA high mode with EDGE on.

Typical values:

Table 12:

Power level	GSM1900 EDGE off
0	0.600 ... 0.750
11	0.130 ... 0.190
15	0.110 ... 0.150
Base	0.090 ... 0.130

GSM1900 PA high mode with EDGE on

Set Power Meter (or Spectrum analyzer) as required.

Repeat the same steps as for EGSM high and low mode above.

When EDGE is on, the tuning must be made for all power levels.

Tune base level and all power levels from 15 to 2 to target level.

When tuning values are correct, choose **"Save & Continue"**.

Typical values:

Table 13:

Power level	GSM1900 EDGE on
2	0.550 ... 0.700
3	0.470 ... 0.620
4	0.400 ... 0.550
5	0.350 ... 0.500
6	0.320 ... 0.470
7	0.290 ... 0.430
8	0.260 ... 0.360
9	0.240 ... 0.330
10	0.220 ... 0.310
11	0.210 ... 0.300
12	0.200 ... 0.280
13	0.180 ... 0.260
14	0.170 ... 0.250
15	0.160 ... 0.240
Base	0.090 ... 0.160

If values shown are within limits select **"Save & Continue"**, values are saved to phone memory.

Close the **"TX Power Level Tuning"** dialog to end tuning.

■ TX I/Q tuning

Spectrum analyzer is needed.

Tx IQ tuning allows changing the Tx I DC Offset, Tx Q DC Offset, Amplitude difference and Phase difference.

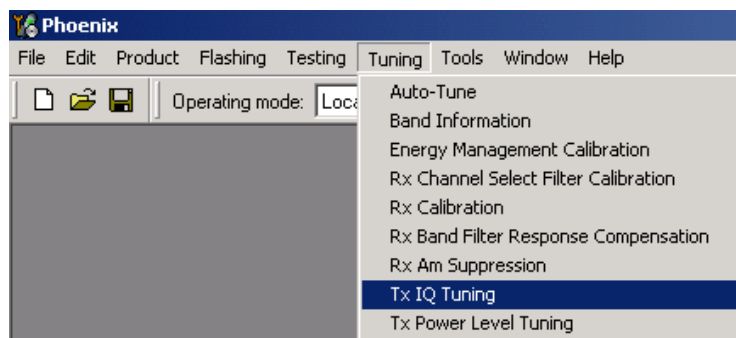
Must be performed separately on all bands!

TX I/Q tuning steps are:

- EGSM (GSM900) with EDGE off
- EGSM with EDGE on
- GSM1800 with EDGE off
- GSM1800 with EDGE on
- GSM1900 with EDGE off
- GSM1900 with EDGE on

Remember to take jig and cable attenuations into account!

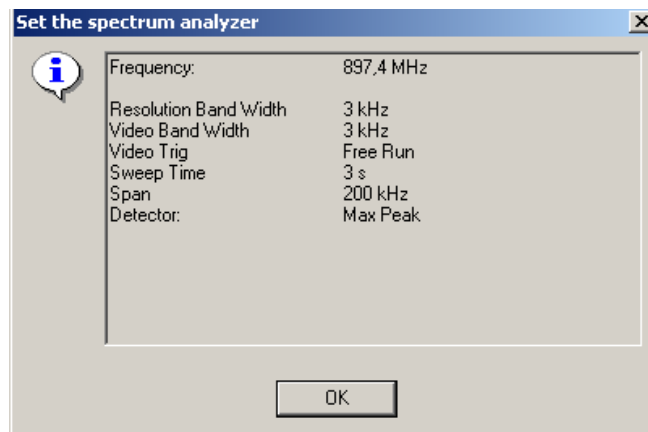
Select **Tuning => TX IQ Tuning**



EGSM900 band with EDGE Off

Select **"Start"** to begin tuning at **EGSM900 band with EDGE off**.

Set spectrum analyzer to required settings => **OK**

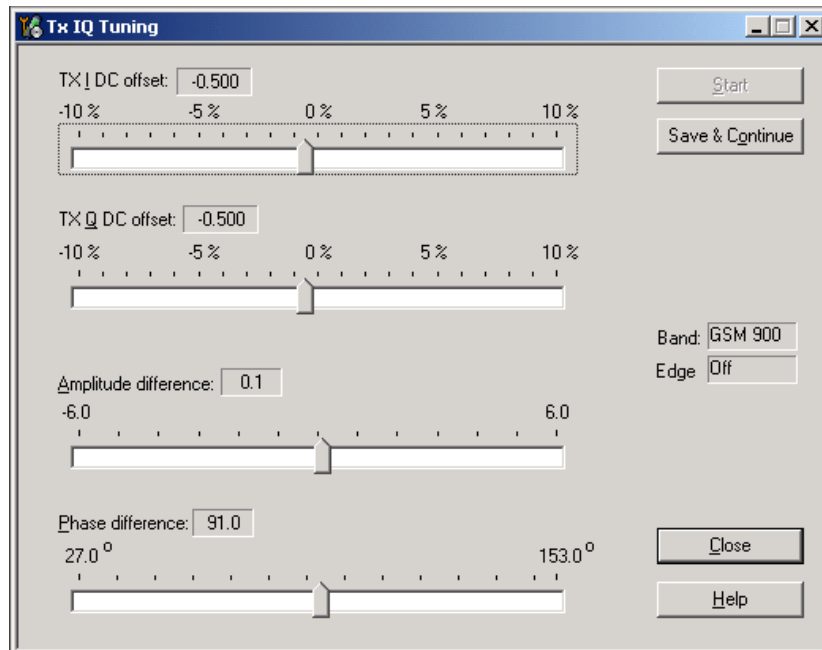


The tuning is carried out by setting each of the sliders to desired value. The sliders can be changed only when the tuning is ongoing.

The order of tuning should be the same as the order of the sliders e.g. the Tx I DC Offset is tuned first and Phase difference is tuned last.

Use <= , =>, PgUp or PgDn keys

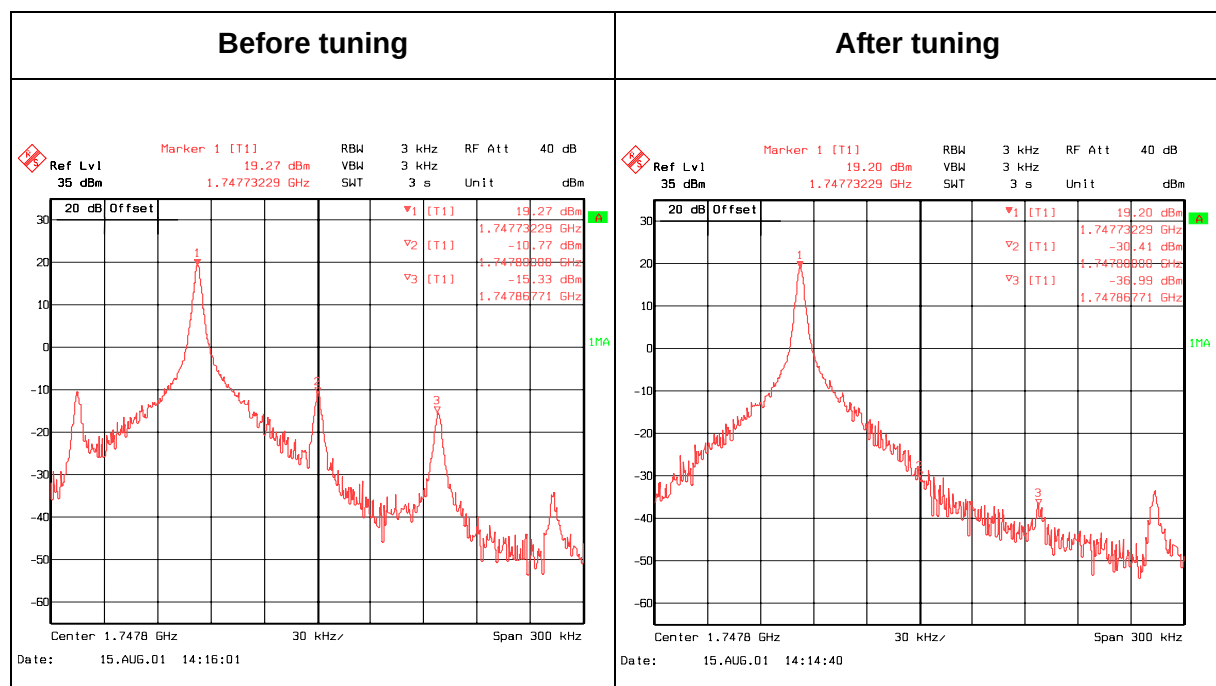
The tuning is performed by setting each of the sliders to desired value.



Tune LO leak to minimum with TXI/TXQ DC offset control (**f0 on spectrum analyzer screen**).

Tune the wrong sideband to minimum using Amplitude/Phase difference controls (**f0+68kHz on spectrum analyzer screen**).

Table 14:



Tx IQ Tuning limits are the same for all bands (GSM900, GSM1800 and GSM1900):

Table 15:

Tuning Limits	EDGE off	EDGE on
TX I DC Offset	-4 ... +4	-6 ... +6
TX Q DC Offset	-4 ... +4	-6 ... +6
Amplitude Difference	-1.2 ... +1.2	-1 ... +1
Phase Difference	80 ... 100	80 ... 100

Tuning will automatically move to the next step, **EGSM900 with EDGE on** when you press **"Save & Continue"**.

EGSM900 band with EDGE On

Choose "Start" to begin tuning.

Set the spectrum analyzer to required settings for EGSM900 band => **OK**

Repeat the same tuning steps as for the EGSM900 with EDGE off above.

Tuning will automatically move to the next step, **EGSM1800 with EDGE off** when you press **"Save & Continue"**.

EGSM1800 band with EDGE Off

Choose "Start" to begin tuning.

Set the spectrum analyzer to required settings settings for GSM1800 band => **OK**

Repeat the same tuning steps as for the EGSM900 band above.

Tuning will automatically move to the next step, **EGSM1800 with EDGE on** when you press **"Save & Continue"**.

GSM1800 band with EDGE On

Choose "Start" to begin tuning.

Set the spectrum analyzer to required settings for GSM1800 band => **OK**.

Repeat the same tuning steps as for the EGSM900 band above.

Tuning will automatically move to the next step, **EGSM1900 with EDGE off** when you press **"Save & Continue"**.

GSM1900 band with EDGE Off

Choose "Start" to begin tuning.

Set the spectrum analyzer to required settings for GSM1900 band=> **OK**.

Repeat the same tuning steps as for the EGSM900 band above.

Tuning will automatically move to the next step, **EGSM1900 with EDGE on** when you press **"Save & Continue"**.

GSM1900 band with EDGE On

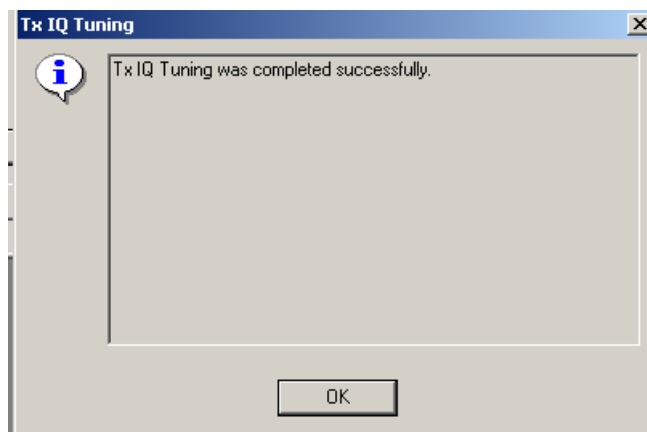
Choose "Start" to begin tuning.

Set the spectrum analyzer to required settings for GSM1900 band=> **OK**.

Repeat the same tuning steps as for the EGSM900 band above.

Tuning will be completed when you press "**Save & Continue**".

Choose "**OK**" to close the "**TX I/Q Tuning**" dialog.



[This page left intentionally blank]